

AMATEUR SATELLITE REPORT

AMSAT® NA Newsletter for the Amateur Radio Space Program



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Editorial ...

by Dr. John Champa, K8OCL

As many of us AMSAT members are aware, but some of us sometimes fail to remember, is that our organization is a volunteer group. That means that putting out our publications, such as this newsletter, is done through the dedication of volunteers. There is no paid publications staff! Our fellow members with families, jobs, and other interests, give freely of their own time because they believe in the AMSAT mission and what it contributes to the space sciences and to the future of the Amateur Satellite Service, and in turn what these accomplishments do for the education of generations to come, and the preservation of the highest ideals in the best traditions of Amateur Radio in general. Sure, that level of commitment can be great fun and thrills, but it can also be a great deal of work too, such as when it comes to writing it all down for others to see.

Well, you'd hope that when our previous editor of this newsletter resigned, that we'd have replacements standing in line to take his place. That's not the case. The reality of life in volunteer organizations is that a relatively few members, counting from AMSAT Area Coordinators through the AMSAT President, service the needs of the remainder. So, we had to go find a new editor. Fortunately an outstanding individual volunteered to take on the job: Joe, Kasser, G3ZCZ.

While Joe is getting our new publication together in a magazine format, the *AMSAT-NA Journal*, several of us have been "filling in" as ASR editors. Your understanding and patience during this transition has been appreciated. A strong emphasis is being placed on keeping members informed, but some publication release dates are being missed. To help compensate for some of this inconvenience, we've gone to double issues (8 pages instead of 4) and if your membership expiration date was in November or December of 1988, we've kept you on the mailing list — until now. The transition period is about to come to an end. If you need to renew your membership, you are encouraged to do so soon.

AMSAT-NA is about to celebrate its 20th Anniversary and the Amateur Space Program is on the brink of its most dynamic period: Microsats, UoSATs, Phase IIID, Phase IVA,

Amateur Radio operators in space, onboard the Mir Soviet Space Station and the US Space Shuttle, and more. Hope you'll stay with us and be a part of this history in the making. Your support and involvement are much needed.

If you have a comment on this editorial, please feel free to write to me at my home address: Dr. John Champa, K8OCL, AMSAT-NA Executive Vice President, 7800 Hartwell Street, Dearborn, MI 48126-1122.

AMSAT Board of Directors Supports a Code Free UHF License

The following is the text of a letter sent to the American Radio Relay League, Inc. regarding Amateur No-Code Licenses. Any members who have comments regarding the AMSAT-NA recommendations may direct them to Dr. John Champa, K8OCL, AMSAT-NA Executive Vice President, 7800 Hartwell Street, Dearborn, MI 48126-1122

19 January 1989

Dr. Larry Price, W4RA, President
American Radio Relay League, Inc.
Newington, CT 06111

RE: No-Code Amateur Radio License

Dear Larry,

AMSAT supports the use of Morse Code for communications. OSCAR Satellites of all nations use Morse Code for at least some of the telemetry. While most Amateur satellite communication is via SSB, We encourage CW use because it requires only 10% of the EIRP needed for SSB contacts.

The January QST editorial prompted AMSAT to consider whether a code test for an Amateur Radio License was a desired requirement. The Board of Directors of AMSAT have directed me to make public their unanimous support for a code free license of some type in the VHF and higher spectrum.

We are going ahead with our careful study of the Phase IV geosynchronous satellite. We are also now constructing, with generous help from the League, a new type of satellite

called Microsat. This is primarily a packet radio satellite to operate in the VHF-UHF bands.

One reason Jan King, W3GEY, first proposed Phase IV was the preservation of spectrum. The AMSAT Board of Directors believe that commercial interests view the VHF and higher holdings of the Amateur Radio Service as temporary storage for their future use. Radio Amateurs must do something to make good use of these tremendously valuable allocations or they will go the way of 220 - 222 MHz. During the Mobile WARC attended by Jan, Land Mobile Services told attending representatives they wished to convert the spectrum 1.5 - 3.0 GHz to primary land mobile with no secondary allocations. This is totally unacceptable to the future growth plans in the Amateur Satellite Service and completely incompatible with development trends in packet radio. AMSAT is planning future satellites with higher data rates in the L and S bands of the Amateur Satellite Service to be used in a store and forward system to take some of the burden off 20 Meter-HF for moving cross-country traffic.

We believe that our goals can be helped, and our bylaws to encourage use of the higher frequency bands and promote education in the space sciences supported, by a code free license which allows access to Amateur space communications by additional technically qualified individuals. The generally envisioned requirement for such a license is the Technician level Element 3A coupled with 25 questions covering satellite, digital, and microwave communications. Successful completion of this test would grant the licensee full Amateur privileges in the Amateur frequencies above 220 MHz, including the satellite sub-bands for access to Modes B, L, and S.

73,

Doug Loughmiller, KO5I
President

The Board of Directors, duly elected to be your representatives, has decided to be a leader in the effort in what is clearly a controversial issue. We know it will make some of our members quite unhappy. We wish to convey our reasoning and motives.

We believe that it is vital to the continued existence of the Amateur Satellite Service. The leadership we have provided in this area is based on some unique experience on our Board of Directors in the area of spectrum allocation on a national and international level. Jan King, W3GEY, Chairman of the Board of AMSAT-NA, and its long-time Vice President of Engineering, had the honor of being a US delegate to the land mobile services WARC meeting in Geneva in 1987. During this meeting he became acutely aware of the growing pressure from land mobile services for increased spectrum allocations all over the world. Indeed in the final official document of this meeting, the land mobile service passed a resolution calling for a mobile WARC in 1991 or 1992 during which all frequencies from 1.3 GHz to 3.0 GHz would be converted to land mobile as a primary allocation. This would effectively end the Phase IV project, the continuation of the Microsat project, and the AMSAT-DL Phase IIID project.

The land mobile service is the 'designer jeans' of the current radio telecommunications industry with the growing use of cellular phone and other needs for instantaneous communications by industry. UPS, in its fierce competition with Federal Express and others, feels the strong need to be able to redirect its trucks to immediate pickups in the field as FedEx does now. It was the only strong voice amongst a sea of amateur, government, and even others in the land mobile service who saw no reason to grant land mobile 220-222. Nevertheless, the commissioners, sensing the global push for new land mobile spectrum, went ahead and reallocated this to land mobile. The battle is not over and we cannot afford to lose. The previous US administration has begun the talk of *auctioning off* spectrum to the highest bidder without relying on the tried and true tested method of defending the need for the spectrum and proving it was in the public interest to allocate that spectrum to the source of the request. This comes at a time when for all intents and purposes, the amateur population is constant. Next to the increasing community of users in the land mobile service, we look like a shrinking percentage of the market for spectrum and, nevertheless, are holding large portions of valuable spectrum, primarily in the VHF and higher.

Your Board of Directors believes it is vital that we protect the irreplaceable resource we have for the Amateur Satellite Service, the burgeoning packet radio community, and amateur radio in general. The amateur satellite engineering program, that we have been working on for several years, mandates that we use wideband techniques in the threatened region of spectrum in the near future. The Directors, having looked at the issue of use of our spectrum in the UHF and microwave region for some time now, see no alternative but to open the ranks of the amateur radio service to a new collection of people. The current amateur population is just not interested in moving to this spectrum or we would have already seen the movement. We believe, as does TAPR and others, that the best available tool we have at this time, is a code free license, with a technical test not less difficult than the Element 3A with additional questions on satellites, digital communications, and microwave. This would, if structured properly, have little impact on the current population of amateurs in that most of them do not use frequencies above 220 MHz. We do not propose to give two or six meter privileges to this new class of licensee and international treaty mandates Morse Code proficiency for operation below 30 MHz.

Your Board of Directors hopes that we will have the support of the majority of our members. The motion to send the letter and to become involved with this effort was passed without dissent. Indeed, it was on a positive vote by all Directors except Director Riportella, who was absent from the board meeting.

Ten-Meter Downlink Passband Being "QRM'ed" By FM Stations

In recent months there has been a growing awareness among OSCAR satellite users that the 10-Meter downlink spectrum of 29.300-29.500 MHz is being disrupted by 10-Meter FM stations. All radio amateurs are reminded that

this spectrum has been set aside by international agreement for use as a downlink passband for Mode A satellites, eg., RS 10/11. By operating within this spectrum, 10-Meter FM stations "wipe-out" a considerable portion of the downlink spectrum and render it useless for RS 10/11 satellite users. All RS 10/11 users who do encounter this situation should politely remind the QRM'ing station about the vital role this portion of the 10-Meter spectrum plays in the Amateur Satellite Service. Amateurs not involved in using OSCAR satellites are requested to honor this "gentlemen's agreement" and avoid using 29.300-29.500 MHz.

U4MIR Comes to Life

by Ray Soifer, W2RS

Stations around the world have been reporting hearing and working U4MIR. According to Hans, ZS6AKV, stations in southern Africa worked the new Mir station as early as Thursday, Feb. 9. Pat, G3IOR, worked U4MIR on Friday the 10th. By Saturday, Feb. 11, many stations in eastern Canada and in Europe were reporting contacts, including Bill, VE3EFX, and his XYL VE3HIR. W2RS had one at 1938 UTC on Sunday, Feb. 12, and another the same day at 2113 UTC.

On Friday, Feb. 17, U4MIR came up on four passes over North America, 17249 Through 17252, working stations rapid-fire on 145.55 MHz FM simplex. He was worked by W2RS at times ranging from 1533 to 2017 UTC. Contacts generally consist of a simple exchange of call signs, with an occasional "please repeat" or "dos vedaniya" thrown in.

VE3EFX reports that the new operator's name is Alexander. His English is quite poor and he does seem to be having some trouble with call signs. But he is trying, so please speak slowly and distinctly, sticking to standard ICAO phonetics. Most of these contacts, including that of W2RS, were made on 145.550 simplex. Alexander also seems to be using 145.650 as a secondary frequency; several simplex contacts were made there as well. So far at least, Alexander seems to be keeping the same general hours as did Musa, U2MIR, in that most contacts are being made at about 1900 UTC or later, in the period between the cosmonauts' dinner hour and lights-out. Mir's operations schedule is on Moscow time, which is three hours ahead of UTC.

When calling U4MIR, best results will be had if you keep calls short, listen frequently and stick to standard ICAO phonetics. He seems to understand those readily although his English is fragmentary at best. As with other manned spacecraft, use of the latest Keplerian elements is generally necessary because of the rapidly-changing orbit. A directional antenna also helps to hear the spacecraft through other callers, as well as improving your own signal in U4MIR's receiver.

Pat, G3IOR, reports that a new crew will be going up in April, and is receiving Amateur Radio instruction on the ground. We look forward to more Amateur operation from the spacecraft as times goes on. No new QSL information has been received, so until further notice cards should probably still go via Boris Stepanov, UW3AX, P. O. Box 679, Moscow 107207, USSR.

Please continue to report information concerning Mir to AMSAT net control stations so that it may be passed on to others.

GETTING ON AMSAT-OSCAR-13 WHAT IT TAKES

by Andy MacAllister, WA5ZIB

You may have read "how-to" write-ups on satellite operation telling you that contacts can be made with simple systems using inexpensive radios and home-made antennas. They are right. Many AMSAT-OSCAR-10 enthusiasts proved that with the right conditions, a few watts to a small manually-pointed Yagi or more power into a mobile mag-mount can provide uplink signals, and that a dipole hung on the wall followed by a small receive converter and an HF rig can hear signals from space. It's been done many times.

This is a guide for Mode B satellite activity, not a description of a QRP (low power) satellite station or an indoor antenna system. If your station is easy to use and provides satisfying contacts, you will operate more often and learn ways to further improve your station. Very rarely does a new satellite chaser put together all of the ingredients for the optimum earth station at one time. It is a process of experimentation and learning.

So, how do you get a station ready for AO-13? The most popular transponder on AO-13 is Mode B. This requires an uplink signal from you, using CW or lower sideband from 435.423 to 435.573 MHz. Most contacts are made on uplink frequencies close to 435.500 MHz. Downlink reception is from 145.975 to 145.825 MHz, CW or upper sideband. The Mode B transponder is inverting, thus a lower sideband transmission on 435.443 MHz will result in an upper sideband signal on 145.955 MHz while an uplink on 435.553 MHz will come out on 145.845 MHz. CW activity is usually heard below 145.900 MHz while sideband users stay above 145.900 MHz.

Since the VHF and UHF bands used by AO-13 are



N. Texas Area Coordinator Keith Berglund, WA5ZDP, and AMSAT Secretary Martha Sargovitz at the Atlanta Board Meeting

primarily line-of-sight, satellite access is only possible when AO-13 is above your horizon. The best way to predict when AO-13 will be available from your location is with a home computer and a good satellite tracking program. AMSAT offers software for many computers. Some programs provide simple tabular listings showing basic tracking information, while others can produce world maps with real-time, multi-satellite tracking. Regardless of your program's complexity, the key point is to know when to operate and where to aim the antennas. If you do not have a computer, there are mechanical aids for tracking or a friend may be able to print predictions for you. Due to the elliptical shape of AO-13's orbit, guessing the satellite's position won't work. Long-term commitment to satellite chasing requires access to a computer with tracking software.

Most active operators have multi-mode, two-meter and 70-cm transceivers. Commonly heard rigs include the Yaesu FT726R or FT736R, the ICOM IC271 and IC471 pair (A or H suffix), the IC275 and IC475 pair (A or H suffix), the Kenwood TS711A and TS811A pair, the Kenwood TS790 or the Ten-Tec 2510B. For those with the H suffix ICOM rigs (high power of 75 watts) no external amplifiers are used. Others with 25 watt radios usually buy an amplifier. The idea is not to overpower the satellite, but to have the extra output available when the satellite does not favor your location. An example would be when AO-13 is at apogee (highest point of the orbit) with its gain antennas pointed away from you. Amplifiers commonly used include Mirage, TE Systems and RF Concepts. You will have consistent and satisfying results with 50 to 100 watts.

Quality coaxial cable and good antennas up in the clear round out the complete earth station. For the cable, most use Belden 9913 coax with "N" connectors made for the slightly larger center conductor of the 9913. Keep the coax runs short. If the rig or antennas use SO239 connectors then use PL259A connectors (Teflon dielectric) on the cable. Avoid jumpers and extra coax adapters.

Satellite antennas don't need to be up high, they just need to "see" the sky. It's best to have an unobstructed view of the horizon in all directions. Trees and buildings attenuate both received and transmitted signals. Commonly used antennas are circularly-polarized, commercially-built crossed Yagis. Manufacturers include Cushcraft, Telex/Hy-Gain, KLM/Mirage, Tonna and Spectrum International. The first three brands are the easiest to find.

The AOP-1 package from Cushcraft includes a 20-element two-meter crossed Yagi, a 16-element, 70-cm crossed Yagi and a mounting boom with mounting plate suitable for use with the Alliance U100 rotor (used for elevation control). It does not come with polarization switching and it does not use stainless steel hardware, but it is the least expensive. The cable harness is typically set for RHCP (right hand circular polarization) to conform with most satellites. The individual antennas, crossboom and mounting plate can be purchased separately if necessary. A polarity switcher is available for the 70-cm antenna and a 10-element two-meter crossed Yagi is an alternative for those with space constraints. The smaller antenna exhibits less gain.

The OSCAR Link antenna system from Telex/Hy-Gain offers advantages over the Cushcraft system, but averages about \$100 more. It includes a 16-element two-meter

crossed Yagi, a 30-element 70-cm crossed Yagi and a heavy-walled fiberglass crossboom. Hardware is stainless steel with ultra-violet stabilized plastic insulators. Many other items have been carefully engineered, including polarization switching relays rated at 200 watts. For a cost-effective system with excellent performance, this antenna array is the best choice.

The finest and also the most expensive antennas are made by KLM/Mirage. Two versions of the two-meter crossed Yagi are available. One has 14 elements and the other has 22. Just the 2M-22C (22-element antenna) costs more than the complete Cushcraft package but includes switcher and stainless hardware. For 70-cm, there is either an 18-element or 40-element antenna.

Inexpensive rotators do well with satellite antennas. Typical arrays offer the same wind-loading as large TV antennas. The only difference is that two rotators are required to give both azimuth and elevation control. Although rotators are specifically made for elevation control, most Hams use simple azimuth rotators like the Alliance U100 types turned on their side. Computerized antenna control is nice but unnecessary for AO-13 tracking. Yaesu offers a dual-axis system that interfaces easily, but it is expensive.

Most stations have preamps. For a few, signals from the satellites are sufficient without a preamp. These stations have state-of-the-art radios with GaAsFET front ends and large antenna arrays. For those with long coax runs, preamps are placed at the antenna. This way, weak downlink signals are amplified before they are lost in the coax. With a short coax run the preamp can be placed near or in the radio. Commonly used preamps are made by Advanced Receiver Research, Hamtronics, Landwehr (from Henry Radio) and Microwave Modules Ltd (from Spectrum International).

There are many ways to get a functional satellite station on the air. Other manufacturers of VHF and UHF rigs and antennas exist and tracking software has been written and sold by companies and individuals other than AMSAT. Other transponder modes are available via AO-13, but getting a fully functional Mode B station on the air is an important start.

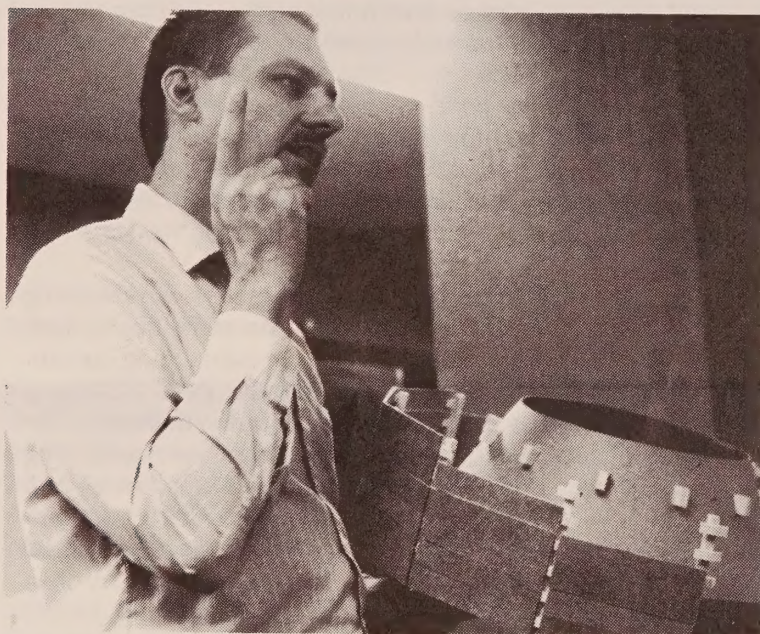
For further information consult the *ARRL Handbook*, *The ARRL Operating Manual*, *The Satellite Experimenter's Handbook*, many AMSAT publications and the AMSAT HF and satellite nets. *QST* provides a monthly column, "Amateur Satellite Communications" and *73 Amateur Radio* supports the "Hamsats" column.

Portable UoSAT OSCAR-11 Station Tested

The Digital Communication Experiment (DCE) aboard the University of Surrey UO-11 satellite was designed to be a demonstration of the store-and-forward concept utilizing low earth orbiting satellites. This experiment is the forerunner to the MicroSat/UoSAT satellites to be launched late next year. The concept of storing messages and then having another station on the other side of the world retrieve them has been successfully demonstrated with UO-11 and the various DCE stations around the world.

Jeff Ward, K8KA/GØ, has reported that a new experiment

using the DCE has shown that a completely portable station, free from commercial power and fixed antenna structures, has further demonstrated the usefulness of the DCE and future MicroSat/PACSAT satellites. This portable station was built by University of Surrey engineer Victor van der Zel and has been operated successfully on several occasions. The station consists of a Kenwood 721, transmitting on 2 meters and receiving on 70 cm, and a G3RUH demodulator. With the built in digital EIA RS-232-C interface on the 721, Victor has been able to interface it with a Toshiba 1100 laptop computer to control frequency to compensate for Doppler shift. The antennas are homebrewed 3-element quads which are manually pointed and are designed to be easily assembled. With this station it is now possible to investigate the emergency communications possibilities of the future series of MicroSat/PACSAT/UoSAT satellites from remote locations. The information learned from this experimental station and the DCE experiment will help designers of future Amateur Radio satellites.



Bill Clapp of Weber State College with an early stage model of a Phase IV satellite addresses the AMSAT-NA Board of Directors meeting in Atlanta. (Photo by WA5ZIB)

NEW BYLAWS APPROVED BY BoD

by Ray Soifer, W2RS

After almost two years of work, the Board of Directors at its November meeting approved a new set of corporate bylaws. According to VP and past Director Ray Soifer, W2RS, who headed the project, this was the first top-to-bottom review of AMSAT-NA's "constitution" since 1969. The primary object, Ray says, was not to make major changes, but rather to produce a governing instrument that reflects the way the organization actually works today. Several administrative "glitches" that had developed over the years also were addressed in the new document. Among these were the budget process, financial controls, the timetable for election of Directors, and, perhaps most important, clarifying the lines of authority so that ultimate power resides fully in the Board, which is elected directly by the members.

In addition to the new bylaws, the BoD authorized several necessary amendments to the articles of incorporation. The first three articles are reprinted here in their updated form;

the rest of that document provides that members and member societies shall be those who complete applications for membership and who pay dues as provided in the bylaws, and that candidates for the BoD may be nominated by any five members or any member society. "Boilerplate" provisions required by the District of Columbia incorporation laws and the Internal Revenue Code complete the articles.

In accordance with both the "old" and "new" documents, the amended articles of incorporation are already in effect following their approval and filing, while the amended bylaws shall take effect 30 days following the mailing of this publication to the membership, unless written objections shall have been received from at least 10% of the members. The complete text of the proposed bylaws is as follows:

BYLAWS of the RADIO AMATEUR SATELLITE CORPORATION

#These Bylaws have been adopted pursuant to the Articles of Incorporation, which provide, in part, as follows:

#FIRST: The name of the corporation is Radio Amateur Satellite Corporation.

#SECOND: The period of duration is perpetual.

#THIRD: Said corporation is organized exclusively for scientific purposes, including, for such purposes, the making of distributions to organizations that qualify as exempt organizations under Section 501(c)(3) of the Internal Revenue Code of 1954, as amended (or the corresponding provision of any future United States Internal Revenue Law).

##The scientific purposes for which said corporation is organized shall be the carrying on of scientific research in the public interest by the means of:

##A. Developing and providing satellite and related equipment and technology used or useful for amateur radio communication and to conduct experiments by suitably equipped amateur radio stations throughout the world on a non-discriminatory basis.

##B. Encouraging development of skills and the advancement of specialized knowledge in the art and practice of amateur radio communications and space science.

##C. Fostering international goodwill and cooperation through joint experimentation and study, and through the wide participation in these activities on a noncommercial basis by radio amateurs of the world.

##D. Facilitating communications by amateur satellites in times of emergency.

##E. Encouraging the more effective and expanded use of the higher frequency amateur radio frequency bands.

##F. Disseminating scientific and technical information derived from such communications and experimentation, and encouraging publication of such information in treatises, theses, publications, technical journals and other public means.

##G. Conducting such lawful activities as may be properly incident to or aid in the accomplishment of provisions A-F hereinabove, and which are consistent with the maintenance of tax-exempt status pursuant to Section 501(c) of the Internal Revenue Code.

ARTICLE I

Members and Member Societies

#Section 1: Membership as Member or Member Society shall become effective upon receipt of the appropriate completed application form and dues by the Secretary, and shall cease immediately upon resignation or upon expiration of the period for which dues have been paid.

#Section 2: Dues for Members and Member Societies shall be those established from time to time by the Board of Directors (the "Board"), a majority of two-thirds of the Directors being required for adoption. A Member submitting the appropriate application and paying such amount as may from time to time be so established for this purpose shall be forever exempt from annual dues, and shall be known as a Life Member. A minimum of one renewal notice shall be sent to each Member and Member Society prior to the expiration date of its membership.

ARTICLE II

Elected Officers, Committees, Appointed Officials and Their Responsibilities

#Section 1: The Board shall have the power to hold meetings, adopt rules for its functioning (including the determination of an agenda for each meeting), appoint committees, elect, suspend or remove Officers, fix their duties to the extent not otherwise provided in these Bylaws, and take all necessary and proper steps to carry out the purposes of the corporation and these Bylaws. At least annually, the Board shall determine a budget for the corporation's revenues and expenditures in accordance with the system of accounts prescribed in Section 5 of this Article, and may amend such budget at its discretion. No financial obligation shall be incurred by or on behalf of the corporation except by prior approval of the Board; provided, however, that the Board may, at its discretion, authorize any Officer or Officers to incur such obligations and/or to approve such necessary or incidental obligations as may be incurred by officials acting under such Officers' authority, subject to such limits and procedures as the Board shall determine.

#Section 2: The Board shall consist of seven Directors, who shall be Members elected according to the procedure set forth in Article III of these Bylaws. Each Director shall be elected for a two-year term. Four Directors shall be elected in odd-numbered years; three shall be elected in even-numbered years. Directors and Alternates shall assume office immediately upon the announcement of their election by the Secretary as provided in Article III. The retiring Directors shall be responsible for assuring the orderly and effective transfer of records and responsibilities to the incoming Directors.

#Section 3: The Board, at its first meeting following each election of Directors, shall elect the Officers from among the Members. Officers shall serve at the pleasure of the Board until the next annual election of Officers. Newly-elected Officers shall assume their respective duties immediately upon their election and acceptance. The retiring Officers shall be responsible to the Board for assuring the orderly and effective transfer of records and responsibilities to the incoming Officers.

#Section 4: Officers of the corporation shall be the President, the Executive Vice President, the Vice President-Engineering, the Vice President-Operations, the Secretary, the Treasurer and the Manager. Additional Officers may be elected, and their duties established, by the Board at its discretion subject to these Bylaws. A Member may hold more than one office. Officers shall be charged with the execution of policies, programs and directives of the Board of Directors.

#Section 5: The duties of the Officers shall be as follows:

A. The President shall preside at the Annual Meeting and at all other meetings of the membership, and shall act in the place of the Chairman of the Board in the latter's absence. The President shall be responsible to the Board for coordinating all activities of the corporation and for all matters not otherwise assigned herein or by the Board. The President shall report to the Board at each meeting on the status of the corporation's affairs and shall, as required by the Board, prepare and distribute a proposed budget of the corporation's expenditures, prepared according to the system of accounts prescribed in this Section 5, which proposed budget shall be based upon the revenue estimate prepared and submitted by the Treasurer. The President may, on his own motion, and shall, at the request of at least three directors, call special meetings of the Board of Directors.

B. The Executive Vice President shall act in the place of the President in the President's absence, and shall have such other duties as the Board may determine.

C. The Vice President-Engineering shall be responsible for managing the activities of such technical staff as the corporation may have, and shall have such other duties as the Board may determine.

D. The Vice President-Operations shall be responsible for managing the activities of such operations staff as the corporation may have, and shall have such other duties as the Board may determine.

E. The Secretary shall be responsible to the Board for maintaining minutes of all meetings of the corporation and of the Board, and, with the assistance of the other Officers, for maintaining the corporate status of the corporation and for preparing and submitting such documents as may be required in connection therewith. The Secretary shall also be responsible to the Board for maintaining the membership records of the corporation, and shall receive all applications for and renewals of membership. Under the authority of the Board, the Secretary shall conduct the elections for the position of Director as provided hereunder. The Secretary shall have such other duties as the Board may determine.

F. The Treasurer shall be responsible to the Board for managing the funds and investments of the corporation, and shall report to the Board at each meeting on the corporation's financial condition. Subject to the Board's approval, the Treasurer shall establish and maintain a system of accounts for the corporation's use. With the assistance of the other Officers, the Treasurer shall be responsible to the Board for accounting for all revenues and expenditures of the corporation, for preparing such financial reports as may be required, and for ensuring compliance by the corporation with the Internal Revenue Code and with the tax laws of such jurisdictions as may apply. The Treasurer shall prepare and submit to the President, as required for the budget process provided for herein, an estimate of the corporation's revenues including a statement of the assumptions upon which such estimate is based. The Treasurer shall have such other duties as the Board may determine.

G. The Manager shall operate the principal business office of the corporation and shall assist such other Officers in the performance of their duties as the Board may require. The Manager shall have such other duties as the Board may determine.

#Section 6: Subject to the authority of the Board, any Officer may appoint officials who shall serve in accordance with the terms of their appointments. Such officials shall not be considered Officers for purposes of these Bylaws unless also elected as such by the Board.

#Section 7: Resignations and vacancies in office shall be dealt with as follows:

A. Thirty days' written or telegraphic notice to the Board, in care of the Secretary, shall be required before the resignation of any Officer can be effective.

B. In event of the resignation, death or incapacity of the President, the Executive Vice President shall assume the office of President until the next meeting of the Board, at which time the Board shall elect a President.

C. In event of the resignation, death or incapacity of any other Officer, the President shall appoint a temporary Officer to fill the vacancy until the next meeting of the Board, at which time the Board shall elect a successor.

D. Officers elected pursuant to this Section 7 shall serve at the pleasure of the Board until the normally scheduled expiration of the term of the Officer whose resignation, death or incapacity gave rise to their elections.

E. In event of the resignation, death or incapacity of a Director, the First Alternate shall fill the position until the next annual election of Directors, and the Second Alternate shall become First Alternate. At that election, a Director shall be elected to fill any unexpired term of such former Director, in addition to the Directors scheduled to be elected at that time. In event of the resignation, death or incapacity of the First Alternate, the Second Alternate shall become First Alternate.

ARTICLE III

Meetings and Election of Directors

#Section 1: An Annual Meeting of the corporation shall be held during October or November of each year at such time and place as the Board shall determine. The membership shall be given not less than 180 days written notice of the time and place of such Annual Meeting. At this meeting, the President shall present a report to the members.

#Section 2: Written nominations of Members for the position of Director, which nominees shall have agreed to serve if elected, shall be received by the Secretary at least 120 days before each Annual Meeting. Such nominations must be in form specified by the Secretary and, to be effective, must be found by the Secretary to be in compliance with the requirements of the Articles of Incorporation.

#Section 3: Voting shall be conducted by secret ballot in a fair and democratic manner. The Secretary shall prepare written ballots listing all candidates found to be duly nominated and eligible for election. Such ballots shall be mailed to all Members or, at the Secretary's discretion, included in a publication of the corporation mailed to all Members, in either event such mailing to take place not later than 60 days prior to such Annual Meeting.

#Section 4: Ballots, to be counted, must be received by the Secretary not later than 30 days prior to each Annual Meeting. As soon thereafter as is reasonably practicable, the ballots shall be counted under the Secretary's supervision. Results shall be publicly announced by the Secretary not later than 21 days prior to each Annual Meeting, such announcement to include written or telegraphic notice to all candidates for election as well as all current Directors. The candidates receiving the largest number of votes shall be declared elected to the seats being contested. The two candidates receiving the next largest number of votes shall be declared First Alternate and Second Alternate, respectively, to serve until the next annual election of Directors or as provided in Article II, Section 7 hereof.

#Section 5: The Board shall meet in person as soon as practicable after the Secretary's announcement of election results for the purpose of electing Officers and for such other business as may properly come before the Board. Additional meetings of the Board may be held at its discretion. The Board may also establish rules providing for telephone or telegraphic consultations in addition to the meetings required under these Bylaws, but no such consultation may result in official actions of the Board unless all Directors have been given timely and adequate notice of such events and afforded reasonable opportunity to participate, and unless the Secretary has kept the minutes of such consultation. At any meeting or consultation of the Board, a simple majority of Directors shall constitute a quorum.

ARTICLE IV

Amendment of the Bylaws

#Adoption of and amendments to these Bylaws shall require the written approval of two-thirds or more of the Directors. Notice of an adoption or amendment which has received such approval, including the text thereof, shall be mailed to all Members by the Secretary, or, at the Secretary's discretion, included in a publication of the corporation mailed to all Members. Such adoption or amendment shall be effective thirty days after the mailing of such notice or publication, unless written objection is received from at least ten percent of the Members in which case a vote shall be conducted by the Secretary in the manner specified for election of Directors. In any such vote, such amendment, to become effective, shall require a majority vote of those Members voting.

Orbit Predictions

AMSAT Orbital Elements for OSCAR Satellites from W0RPK, Feb. 18, 1989

Satellite	UO-9	Satellite	FO-12
Catalog number	12888	Catalog number	16909
Epoch time:	89045.05722778	Epoch time:	89038.07742442
Element set:	452	Element set:	129
Inclination:	97.5800 deg	Inclination:	50.0179 deg
RA of node:	92.1548 deg	RA of node:	338.2722 deg
Eccentricity:	0.0002151	Eccentricity:	0.0011061
Arg of perigee:	185.2805 deg	Arg of perigee:	13.5524 deg
Mean anomaly:	174.8760 deg	Mean anomaly:	346.5603 deg
Mean motion:	15.44274521 rev/day	Mean motion:	12.44397497 rev/day
Decay rate:	5.3918e-04 rev/day ²	Decay rate:	-2.5e-07 rev/day ²
Epoch rev:	40989	Epoch rev:	11320

Satellite	AO-10	Satellite	AO-13
Catalog number	14129	Catalog number	19216
Epoch time:	89043.29488920	Epoch time:	89021.67169254
Element set:	377	Element set:	29
Inclination:	26.6278 deg	Inclination:	57.3622 deg
RA of node:	280.4398 deg	RA of node:	222.9543 deg
Eccentricity:	0.6053625	Eccentricity:	0.6646232
Arg of perigee:	17.0180 deg	Arg of perigee:	197.5144 deg
Mean anomaly:	356.7274 deg	Mean anomaly:	118.7893 deg
Mean motion:	2.05880749 rev/day	Mean motion:	2.09700975 rev/day
Decay rate:	-1.6e-07 rev/day ²	Decay rate:	-1.09e-06 rev/day ²
Epoch rev:	4264	Epoch rev:	466

Satellite	UO-11	Satellite	RS-10/11
Catalog number	14781	Catalog number	18129
Epoch time:	89040.10736581	Epoch time:	89044.85341954
Element set:	404	Element set:	669
Inclination:	98.0213 deg	Inclination:	82.9304 deg
RA of node:	102.5744 deg	RA of node:	329.2615 deg
Eccentricity:	0.0013880	Eccentricity:	0.0012789
Arg of perigee:	8.9875 deg	Arg of perigee:	39.3810 deg
Mean anomaly:	351.1659 deg	Mean anomaly:	320.8312 deg
Mean motion:	14.62939048 rev/day	Mean motion:	13.71941710 rev/day
Decay rate:	2.017e-05 rev/day ²	Decay rate:	1.88e-06 rev/day ²
Epoch rev:	26381	Epoch rev:	8248

**AMSAT Orbital Elements for
Weather Satellites**

Satellite MET-2/14
Catalog number 16735
Epoch time: 89041.84631399
Element set: 277
Inclination: 82.5372 deg
RA of node: 346.8758 deg
Eccentricity: 0.0015664
Arg of perigee: 10.3925 deg
Mean anomaly: 349.7569 deg
Mean motion: 13.83848906 rev/day
Decay rate: 2.53e-06 rev/day²
Epoch rev: 13698

Satellite MET-2/15
Catalog number 17290
Epoch time: 89036.98407380
Element set: 221
Inclination: 82.4678 deg
RA of node: 259.0124 deg
Eccentricity: 0.0012387
Arg of perigee: 271.8885 deg
Mean anomaly: 88.0889 deg
Mean motion: 13.83664810 rev/day
Decay rate: 3.00e-06 rev/day²
Epoch rev: 10547

Satellite MET-2/16
Catalog number 18312
Epoch time: 89041.77348822
Element set: 241
Inclination: 82.5593 deg
RA of node: 319.7003 deg
Eccentricity: 0.0011661
Arg of perigee: 186.0118 deg
Mean anomaly: 174.0910 deg
Mean motion: 13.83420134 rev/day
Decay rate: 3.64e-06 rev/day²
Epoch rev: 7503

Satellite MET-2/17
Catalog number 18820
Epoch time: 89042.03198358
Element set: 84
Inclination: 82.5384 deg
RA of node: 20.7952 deg
Eccentricity: 0.0015557
Arg of perigee: 263.9626 deg
Mean anomaly: 95.9766 deg
Mean motion: 13.84090209 rev/day
Decay rate: 2.14e-06 rev/day²
Epoch rev: 5223

Satellite MET-3/1
Catalog number 16191
Epoch time: 89039.65228076
Element set: 803
Inclination: 82.5509 deg
RA of node: 326.6335 deg
Eccentricity: 0.0018441
Arg of perigee: 260.7677 deg
Mean anomaly: 99.1415 deg
Mean motion: 13.16859281 rev/day
Decay rate: 4.3e-07 rev/day²
Epoch rev: 15860

Satellite MET-3/2
Catalog number 19336
Epoch time: 89039.05906047
Element set: 126
Inclination: 82.5365 deg
RA of node: 267.0285 deg
Eccentricity: 0.0015534
Arg of perigee: 141.7355 deg
Mean anomaly: 218.4817 deg
Mean motion: 13.16854155 rev/day
Decay rate: 3.91e-06 rev/day²
Epoch rev: 2591

Satellite NOAA-9
Catalog number 15427
Epoch time: 89041.43112783
Element set: 333
Inclination: 99.1327 deg
RA of node: 25.9792 deg
Eccentricity: 0.0014881
Arg of perigee: 312.5249 deg
Mean anomaly: 47.4947 deg
Mean motion: 14.11821401 rev/day
Decay rate: 1.069e-05 rev/day²
Epoch rev: 21456

Satellite NOAA-10
Catalog number 16969
Epoch time: 89041.58262838
Element set: 190
Inclination: 98.6510 deg
RA of node: 74.4169 deg
Eccentricity: 0.0012704
Arg of perigee: 257.6903 deg
Mean anomaly: 102.3104 deg
Mean motion: 14.22804260 rev/day
Decay rate: 7.86e-06 rev/day²
Epoch rev: 12593

Satellite NOAA-11
Catalog number 19531
Epoch time: 89034.31541485
Element set: 43
Inclination: 98.9253 deg
RA of node: 339.0838 deg
Eccentricity: 0.0011131
Arg of perigee: 251.6699 deg
Mean anomaly: 108.2990 deg
Mean motion: 14.10792410 rev/day
Decay rate: 5.93e-06 rev/day²
Epoch rev: 1859

**AMSAT Orbital Elements for
Manned & Misc. Satellites**

Satellite MIR
Catalog number 16609
Epoch time: 89044.56559894
Element set: 691
Inclination: 51.6221 deg
RA of node: 266.8741 deg
Eccentricity: 0.0011774
Arg of perigee: 270.7082 deg
Mean anomaly: 89.2202 deg
Mean motion: 15.71251869 rev/day
Decay rate: 6.3569e-04 rev/day²
Epoch rev: 17185

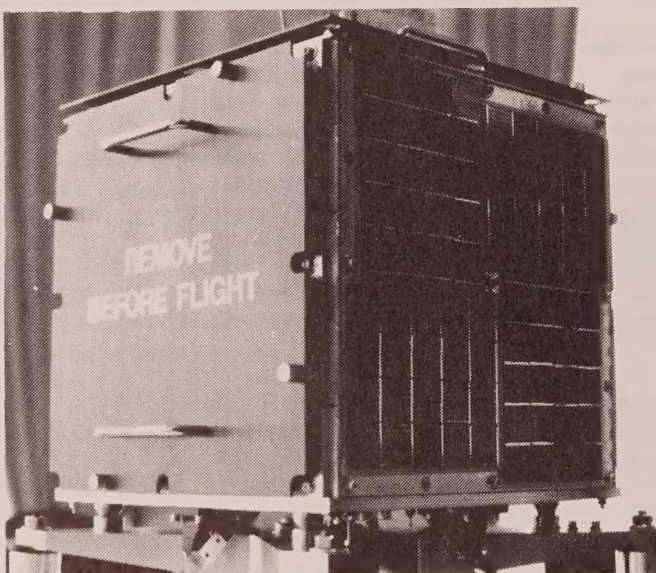
Satellite SALYUT-7
Catalog number 13138
Epoch time: 89044.54814483
Element set: 439
Inclination: 51.6098 deg
RA of node: 201.0171 deg
Eccentricity: 0.0000795
Arg of perigee: 304.5016 deg
Mean anomaly: 55.5987 deg
Mean motion: 15.37328816 rev/day
Decay rate: 1.8273e-04 rev/day²
Epoch rev: 38914

Satellite AJISAI
Catalog number 16908
Epoch time: 89009.42214283
Element set: 115
Inclination: 50.0129 deg
RA of node: 66.1499 deg
Eccentricity: 0.0011053
Arg of perigee: 301.1525 deg
Mean anomaly: 58.8225 deg
Mean motion: 12.44374466 rev/day
Decay rate: -3.6e-07 rev/day²
Epoch rev: 10964

AMSAT® NA

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MICROSAT Flight Model on display at Space Symposium in Atlanta. (Photo by WA5ZIB)

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